U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-259 172

Prairie Rose Lake Shelby County, Iowa

Corvallis Environmental Research Lab, Oreg

Prepared for

Environmental Monitoring and Support Lab, Las Vegas, Nev

Aug 76

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.
3. RECIPIENT'S ACCESSION NO.	
4. TITLE AND SUBTITLE Report on Prairie Rose Lake, Shelby County, Iowa	5. REPORT DATE Prepared August 1976 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)	8. PERFORMING ORGANIZATION REPORT NO. Working Paper # 501
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Eutrophication Survey U.S. Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330	10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460	13. TYPE OF REPORT AND PERIOD COVERED Final - 1974 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

PRICES SUBJECT TO CHANGE

18. DISTRIBUTION STATEMENT Release unlimited	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES 35
	20. SECURITY CLASS *(This page)*	22. PRICE $4.00

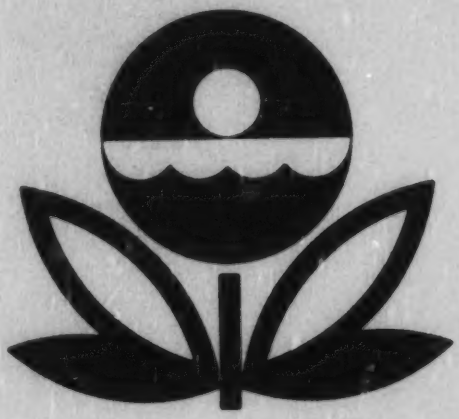
EPA Form 2220-1 (9-73)

309153

PB 259 172

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

G.P.O. 699-440

REPORT

ON

PRAIRIE ROSE LAKE

SHELBY COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 501

WITH THE COOPERATION OF THE

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND THE

IOWA NATIONAL GUARD

AUGUST, 1976

CONTENTS

	Page
Foreword	ii
List of Iowa Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	3
III. Lake Water Quality Summary	4
IV. Nutrient Loadings	8
V. Literature Reviewed	12
VI. Appendices	13

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

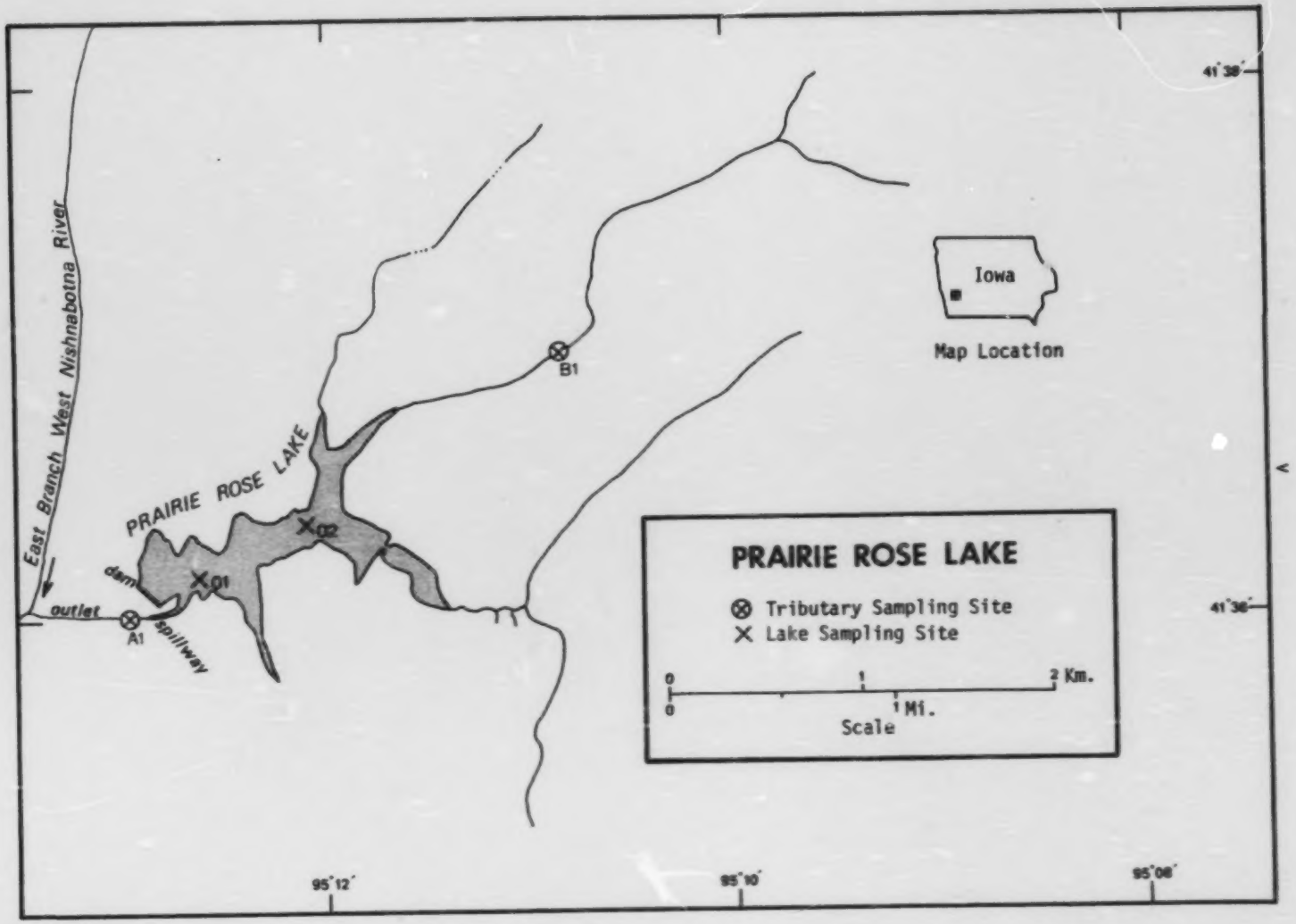
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Ahquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson


41°38'
41°36'
95°12'
95°10'
95°08'
East Branch West Nishnabotna River
PRAIRIE ROSE LAKE
dam
outlet
spillway
A1
B1
X01
X02
Iowa
Map Location
PRAIRIE ROSE LAKE
Tributary Sampling Site
Lake Sampling Site
0
1
2 Km.
0
1 Mi.
Scale

PRAIRIE ROSE LAKE

STORET NO. 1908

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Prairie Rose Lake is eutrophic. It ranked fifth in overall trophic quality when the 15 Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six parameters*. Three of the water bodies had less median total phosphorus, four had less and two had the same median dissolved orthophosphorus, six had less median inorganic nitrogen, eight had less mean chlorophyll a, and six had greater mean Secchi disc transparency.

Survey limnologists noted that the water was very muddy near sampling station 1 in July. They observed an algal bloom throughout the lake and macrophytes and an algal mat at the east end of the lake in September.

B. Rate-Limiting Nutrient:

Due to significant nutrient changes in the samples, the algal assay results are not representative of conditions in the lake at the times the samples were taken (04/17/74 and 09/25/74).

The lake data indicate phosphorus limitation at sampling station 1 and 2 in April and at station 2 in September. Station 1 was nitrogen limited in September.

---

* See Appendix A.

C. Nutrient Controllability:

1. Point sources--No point sources of nutrients are known to impact Prairie Rose Lake. Although the lake is surrounded by Prairie Rose State Park, virtually all of the park sewage is transported out of the drainage basin for treatment and disposal*.

During the sampling year, the lake received a total phosphorus loading of 0.72 g/m^2/year, or more than twice that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). Unless the non-point phosphorus load can be reduced, Prairie Rose Lake can be expected to exhibit progressive symptoms of eutrophication.

2. Non-point sources--All of the phosphorus entering the reservoir during the sampling year apparently came from non-point sources, of which the principal cultural one was agriculture. The one tributary sampled (B-1) contributed about 28% of the total phosphorus load. Minor tributaries and immediate drainage were estimated to have provided about 69% of the total phosphorus load.

A study of land-use practices in the drainage is needed to determine whether any significant reduction of non-point phosphorus inputs can be accomplished.

* Hemminger, 1976.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 0.88 kilometers^2.
2. Mean depth: 3.3 meters.
3. Maximum depth: 8.1 meters.
4. Volume: 2.904 x 10^6 m^3.
5. Mean hydraulic retention time: 1.2 years.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Unnamed Stream B-1	5.7	0.02
Minor tributaries & immediate drainage -	13.8	0.06
Totals	19.5	0.08

2. Outlet -

Unnamed Stream A-1	20.4**	0.08

C. Precipitation***:

1. Year of sampling: 82.3 centimeters.
2. Mean annual: 71.3 centimeters.

---

† Table of metric conversions--Appendix B.
†† Harrison, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Prairie Rose Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at two stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 7.3 meters at station 1 and 2.4 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR PRAIRIE ROSE LAKE
STORET CODE 1908

PARAMETER	1ST SAMPLING (4/17/74) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 2/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/25/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.7 - 11.0	10.3	9.9	23.3 - 24.3	23.8	23.6	15.7 - 16.2	16.0	16.0
DISS OXY (MG/L)	10.0 - 11.2	10.4	10.0	6.4 - 7.6	6.9	6.8	7.0 - 8.0	7.4	7.4
CNDCTVY (MCROMO)	284. - 294.	288.	285.	392. - 397.	395.	394.	283. - 287.	285.	285.
PH (STAND UNITS)	****** -**********			8.2 - 8.4	8.3	8.2	7.8 - 7.9	7.9	7.8
TOT ALK (MG/L)	185. - 187.	186.	186.	****** -**********			164. - 166.	165.	164.
TOT P (MG/L)	0.036 - 0.056	0.043	0.042	****** -**********			0.035 - 0.152	0.077	0.070
ORTHO P (MG/L)	0.007 - 0.017	0.009	0.007	****** -**********			0.009 - 0.015	0.011	0.011
NO2+NO3 (MG/L)	0.750 - 0.800	0.770	0.760	****** -**********			0.090 - 0.160	0.103	0.090
AMMONIA (MG/L)	0.050 - 0.070	0.058	0.060	****** -**********			0.040 - 0.070	0.054	0.060
KJEL N (MG/L)	0.600 - 0.800	0.650	0.600	****** -**********			0.700 - 1.100	0.857	0.800
INORG N (MG/L)	0.810 - 0.860	0.828	0.815	****** -**********			0.140 - 0.210	0.157	0.150
TOTAL N (MG/L)	1.350 - 1.590	1.420	1.360	****** -**********			0.800 - 1.260	0.960	0.980
CHLRPYL A (UG/L)	13.3 - 14.2	13.7	13.7	21.4 - 28.7	25.0	25.0	13.1 - 13.4	13.2	13.2
SECCHI (METERS)	1.0 - 1.2	1.1	1.1	0.8 - 1.0	0.9	0.9	0.7 - 0.8	0.8	0.8

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/17/74	1. Asterionella sp.	7,006
	2. Centric diatoms	2,158
	3. Flagellates	1,487
	4. Dinobryon sp.	835
	5. Ankistrodesmus sp.	435
	Other genera	1,365
	Total	13,286
07/02/74	1. Melosira sp.	522
	2. Anabaena sp.	494
	3. Aphanizomenon sp.	385
	4. Fragilaria sp.	275
	5. Cryptomonas sp.	220
	Other genera	521
	Total	2,417
09/25/74	1. Cryptomonas sp.	766
	2. Closteriopsis sp.	681
	3. Fragilaria sp.	383
	4. Oscillatoria sp.	255
	5. Stephanodiscus sp.	85
	Other genera	42
	Total	2,212

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/17/74	1	14.2
	2	13.3
07/02/74	1	21.4
	2	28.7
09/25/74	1	13.4
	2	13.1

C. Limiting Nutrient Study:

Significant changes in nutrient levels occurred in the assay samples prior to the beginning of the assays, and the results are not indicative of conditions in the lake at the times the samples were taken (04/17/74 and 09/25/74).

The lake data indicate phosphorus limitation at sampling stations 1 and 2 in April and at station 2 in September (the mean inorganic nitrogen/orthophosphorus ratios were 116/1, 61/1, and 16/1, respectively); however, nitrogen limitation is indicated at station 1 in September (the mean N/P ratio was 12/1).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Iowa National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April, May and June, when two samples were collected. Sampling was begun in August, 1974, and was completed in July, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Iowa District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station B-1, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

No known point sources impacted Prairie Rose Lake during the sampling year.

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream B-1	180	28.3
b. Minor tributaries & immediate drainage (non-point load) -	440	69.3
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	15	2.4
Total	635	100.0

2. Outputs -

Lake outlet - Unnamed Stream A-1 170

3. Net annual P accumulation - 465 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream B-1	3,840	27.3
b. Minor tributaries & immediate drainage (non-point load) -	9,300	66.0
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	950	6.7
Total	14,090	100.0

2. Outputs -

Lake outlet - Unnamed Stream A-1 4,705

3. Net annual N accumulation - 9,385 kg.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Unnamed Stream B-1	32	674

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.72	0.53	16.0	10.7

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Prairie Rose Lake:	
"Dangerous" (eutrophic loading)	0.34
"Permissible" (oligotrophic loading)	0.17

V. LITERATURE REVIEWED

Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

Hemminger, Duane (Park Attendant), 1976. Personal communication (Prairie Rose State Park sewage disposal system). Prairie Rose State Park, Harlan.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1901	LAKE ACQUABI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACQUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	296
10	1907	LAKE MACBRIDE	263
11	1914	VIKING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR IOWA 12/23/75

LAKE CODE 1908 PRAIRIE ROSE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 20.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1908A1	20.4	0.02	0.07	0.15	0.09	0.10	0.19	0.10	0.08	0.05	0.04	0.03	0.02	0.08
1908B1	5.7	0.01	0.02	0.04	0.02	0.03	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.02
1908ZZ	14.7	0.02	0.05	0.11	0.06	0.07	0.13	0.07	0.06	0.04	0.03	0.02	0.02	0.06

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 20.4
SUM OF SUB-DRAINAGE AREAS = 20.4

TOTAL FLOW IN = 0.94
TOTAL FLOW OUT = 0.94

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1908A1	8	74	0.02	17	0.03				
	9	74	0.01	5	0.01				
	10	74	0.01	4	0.01				
	11	74	0.01	1	0.01				
	12	74	0.01	8	0.01				
	1	75	0.01	4	0.01				
	2	75	0.01	22	0.01				
	3	75	0.14	1	0.03				
	4	75	0.24	4	0.14	11	0.18		
	5	75	0.14	2	0.22	17	0.10		
	6	75	0.16	9	0.09	24	0.09		
	7	75	0.06	11	0.07				
1908B1	8	74	0.01	17	0.01				
	9	74	0.00	5	0.00				
	10	74	0.00	4	0.00				
	11	74	0.00	1	0.00				
	12	74	0.00	8	0.00				
	1	75	0.00	4	0.00				
	2	75	0.00	22	0.00				
	3	75	0.04	1	0.01				
	4	75	0.07	4	0.04	11	0.05		
	5	75	0.04	2	0.06	17	0.03		
	6	75	0.05	9	0.03	24	0.09		
	7	75	0.02	11	0.02				
1908ZZ	8	74	0.01						
	9	74	0.01						
	10	74	0.01						
	11	74	0.01						
	12	74	0.01						
	1	75	0.01						
	2	75	0.01						
	3	75	0.10						
	4	75	0.17						
	5	75	0.10						
	6	75	0.12						
	7	75	0.05						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

190801
41 36 00.0 095 02 00.0
PRAIRIE ROSE LAKE
19165 IOWA

11EPALES
4

2111202
0028 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/17	15	20 0000	9.9		48	285		187	0.060	0.600	0.750	0.007
	15	20 0005	9.9	10.0		285		185	0.060	0.600	0.760	0.008
	15	20 0015	9.8	10.0		284		185	0.050	0.600	0.760	0.007
	15	20 0024	9.7	10.0		285		186	0.050	0.600	0.760	0.007
74/07/02	12	15 0000	23.6	6.4	40	397	8.20					
	12	15 0005	23.6	6.8		392	8.20					
	12	15 0010	23.4	6.6		394	8.20					
	12	15 0015	23.3	6.4		397	8.20					
74/09/25	10	10 0000	16.2	7.6	29	285	7.83	165	0.060	0.900	0.090	0.012
	10	10 0005	16.2	7.0		285	7.83	164	0.060	0.800	0.090	0.012
	10	10 0015	16.2	7.4		285	7.85	164	0.060	0.800	0.090	0.010
	10	10 0024	16.0	7.4		285	7.85	164	0.070	0.900	0.090	0.015

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/17	15	20 0000	0.045	14.2	
	15	20 0005	0.039		
	15	20 0015	0.037		
	15	20 0024	0.036		
74/07/02	12	15 0000		21.4	
74/09/25	10	10 0000	0.068	13.4	
	10	10 0005	0.069		
	10	10 0006			1.0
	10	10 0015	0.071		
	10	10 0024	0.152		

STORET RETRIEVAL DATE 75/12/23

190802
41 36 00.0 095 02 00.0
PRAIRIE ROSE LAKE
19165 IOWA

11EPALES
4

2111202
0012 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/17	15 50	0000	11.0		40	293		186	0.060	0.700	0.800	0.010
	15 50	0002	11.0	11.0		293						
	15 50	0008	11.0	11.2		294		185	0.070	0.880	0.790	0.017
74/07/02	12 40	0000	24.3	7.6	30	395	8.30					
	12 40	0004	24.3	7.6		394	8.30					
	12 40	0007	24.3	7.2		394	8.40					
74/09/25	09 45	0000	15.9	8.0	31	283	7.89	164	0.050	1.100	0.160	0.009
	09 45	0005	15.7	7.2		287	7.85	166	0.040	0.700	0.100	0.010
	09 45	0008	15.7	7.4		283	7.87	165	0.040	0.880	0.100	0.011

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/17	15 50	0000	0.046	13.3	
	15 50	0008	0.056		
74/07/02	12 40	0000		28.7	
74/09/25	09 45	0000	0.077	13.1	
	09 45	0005	0.035		1.0
	09 45	0008	0.070		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/01/27

1908A1
41 36 00.0 095 13 00.0
UNNAMED STREAM
19 SHELBY CO HWY MP
0/PRAIRIE ROSE RESERVOIR
BRDG W EDGE OF PRAIRIE ROSE STATE PARK
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	15 05		0.176	1.400	0.145	0.020	0.135
74/09/05	08 00		0.480	1.300	0.095	0.025	0.080
74/10/04	07 45		0.840	1.000	0.135	0.020	0.140
74/11/01	13 50		0.048	0.800	0.110	0.020	0.050
74/12/08	13 20		0.224	0.700	0.070	0.010	0.020
75/01/04	17 20		0.144	0.900	0.056	0.013	0.020
75/02/22	16 45		0.195	0.800	0.072	0.016	0.040
75/03/01	16 30		0.185	0.750	0.045	0.010	0.030
75/04/04	18 30		0.810	1.650	0.250	0.010	0.060
75/04/11	17 45		0.980	1.150	0.240	0.010	0.070
75/05/05	18 30		0.065	1.050	0.025	0.015	0.070
75/05/17	19 08		0.870	0.900	0.030	0.030	0.090
75/06/09	16 37		0.320	0.750	0.075	0.020	0.090
75/06/24	17 45		0.155	3.000	0.040	0.030	
75/07/11	16 30		0.220	1.200	0.052	0.025	0.134

STORET RETRIEVAL DATE 76/01/27

190881
41 37 00.0 095 11 00.0
UNNAMED STREAM
19 SHELBY CO HWY MP
T/PRAIRIE ROSE LAKE
2NDRY RD BRDG 4.2 MI SW OF JACKSONVILLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	14 40		4.100		1.800	1.000	
74/09/05	07 45		2.400	0.700	0.075	0.080	0.220
74/10/04	09 20		2.160	0.500	0.075	0.060	0.130
74/11/01	14 00		2.240	0.800	0.360	0.110	0.200
75/04/04	18 20		6.000	7.100	1.400	0.270	1.550
75/04/11	17 50		6.400	1.150	0.095	0.055	0.150
75/05/05	18 40		0.120	1.050	0.015	0.035	0.200
75/05/17	19 05		0.560	0.550	0.145	0.075	0.130
75/06/09	16 55		5.400	0.800	0.090	0.065	0.190
75/06/24	18 00		2.700		0.410	0.155	
75/07/11	17 00		6.300	0.500	0.045	0.060	0.110